ALCOHOL, AGE, AND RISK OF ROAD ACCIDENT INVOLVEMENT

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SYNOPSIS

Research has demonstrated that the relative risk of involvement in road accidents increases with increasing blood alcohol concentration (BAC), especially for BAC's in excess of 80 mg%. Several factors, however, have been shown to influence this relationship. This paper examines one of these factors: age; specifically, the relationship between BAC and the relative risk of fatal accident involvement for different age groups of drivers. Results confirm past findings that people in different age groups have quantitatively different BAC-risk curves. In particular, the relative risk for teen-aged drivers was found to be greater than older drivers, at all BAC's.

INTRODUCTION

In the area of alcohol and road safety, there has been great interest in investigating the overall relationship between alcohol and crash occurrence. In this context, early epidemiologic field studies (Holcomb, 1938; Lucas et al., 1955; and McCarroll et al., 1964), the classic Grand Rapids study (Borkenstein et al., 1964), and a number of similar recent investigations (Farris et al., 1977; Mclean et al., 1970; and Perrine et al., 1971) have established a relationship between blood alcohol concentration (BAC) and risk of crash. Data from 5 such studies (Grand Rapids, Vermont, Farris, Adelaide, and TIRF) are displayed in Figure 1. As can be seen, although there are differences between the estimates of risk in the 5 studies, attributable to a variety of factors, including differences in study method, the type of collision population studied, and the time and location of the study, the risk curves are strikingly similar. For all 5 curves, the risk of collision increases very marginally until 80 mg%, at which point risk increases rapidly with further increases in BAC. Of some interest, the top 2 curves show considerably exaggerated risk at BAC's over 80 mg%. Both of these, from the TIRF study and the Vermont study involve fatal crashes only; the other 3 studies did not. Thus, the risk curves suggest that the relative risk of crash involvement is higher for fatal crashes than for personl injury crashes. The most important
point derived from this figure, however, is the remarkable consistency in the 5 risk curves. The relative risk of collision involvement increases with increasing BAC, especially over 80 mg%.

Such BAC risk curves represent aggregate data, describing the results for the average drinking driver. However, research has shown that the nature of the relationship between BAC and risk of collision is affected by several factors, including the type of accident, temporal factors such as time of day and day of week, annual mileage, drinking frequency, age, sex, and marital status (Borkenstein et al., 1964; Hurst, 1974). With respect to accident type, Hurst (1970, 1974), in calculating relative hazard from 6 different studies (including the Grand Rapid and Vermont studies), found that the acceleration in the upper region of the curve (high BAC's) appears greater for more serious crashes. Similarly, as noted previously, the 5 relative risk curves displayed in Figure 1 suggest that relative risk of crash involvement is higher for fatal crashes than for personal injury crashes. Hurst (1974) also found that frequency of drinking affected the slope of the curve, with more frequent drinkers having generally a lower risk of collision. Finally, Allsop (1966), in his detailed reappraisal of the Grand Rapids data, has demonstrated the different risks for drivers of different ages. Essentially, Allsop found that the risk of accident involvement is higher for drivers aged 18-24 years than older drivers, especially over 80 mg%. Although, data for drivers aged 16 and 17 were only available for one positive BAC range 10-49 mg%, their risk at that BAC was almost times that of drivers aged 18-24 years.

In the present study we sought to replicate and to extend previous findings on the relationship of alcohol and age to fatal crash involvement.

METHOD

We combined 2 Canadian data sets containing information on drivers on the road and fatally injured drivers. Information about drivers on the road was obtained from a roadside survey of nighttime Canadian drivers conducted in 1974 by the Federal Ministry of Transport (Smith et al., 1976). For the purposes of the present study 8,930 cases were used in the data analysis.

Information on fatally injured drivers was obtained from the data base at the Traffic Injury Research Foundation of Canada (Simpson et al., 1978), which includes relevant data on fatal crash victims, including BAC results. The
fatality data were matched with the roadside survey data according to time of crash (2200-0300 hours), and type of vehicle being driven (automobile, motorcycle, truck, or van). This procedure yielded 1,262 fatally injured nighttime Canadian drivers.

The data sets were compared using the risk factors method (Hurst, 1970, 1974) to produce relative risk of fatal crash.

RESULTS

The relative risk curves, generated for 6 different age group, indicate that the relative risk of fatal crash increases with increasing levels of BAC for each age group, without exception (see Figure 2). But, it does so differentially. The risk of fatal crash among young drivers aged 16-19 years is higher than for other age groups at all BAC's. In addition, the slopes of the curves suggest that relative risk rises faster for drivers aged 16-19, than for those aged 20 and over. For these older drivers, the curves overlap considerably. Drivers aged 20-24 and drivers 55 and over generally experience slightly higher risk than the other age groups. These differences, however, are relatively small when compared to the risks faced by 16-19 year-old drivers, at all BAC's. For example, in the BAC range 80-99 mg%, the risk of fatal crash for young drivers is about 40 times greater than risk for the non-drinking driver; at this same BAC the risk for the other age groups is less than 10 times that of the sober driver.

The findings suggest that drivers aged 16-19 have a higher risk of fatal crash than older drivers at all BAC's. To determine whether or not these observed differences are reliable, 95% confidence intervals (Gart, 1962) were placed on the risk estimates for young drinking drivers and for drinking drivers aged 20 years and over. With the exception of Allsop's study and the Adelaide study, confidence intervals have not been placed on the risk estimates. Such confidence intervals are useful, however, in that they illustrate the extent of variability surrounding the point estimates and suggest whether or not the differences are significant. For example, as previously noted, the risk estimate for young drivers in the BAC range 80-99 mg% was about 40. But, the considerable variability around this value may overlap extensively with the reference value (set at 1.0, for the sober driver) or with the risk scores for other age groups.

The age-specific risk curves for BAC's below 80 mg%, with confidence intervals placed around each data point,
indicate that within the BAC range, 50-79 mg% the risk of fatal crash for drinking drivers aged 16-19 is about 9 times greater than that for sober drivers; for drinking drivers aged 20 and over the risk is about 2 times greater (see Figure 3). Although considerable variability surrounds these relative risk estimates, especially for young drinking drivers, the confidence limits do not overlap. Accordingly, the relative risk estimates for young drivers and older drivers appear to be significantly different. Moreover, the relative risk estimates for both age groups in this BAC range appear to be significantly different than the value 1.0, the risk of fatal crash for the average sober driver.

In the BAC range 15-49 mg%, 16-19 year-olds still have a relative risk that differs significantly from the older drivers as well as from sober drivers, but this is not the case for drinking drivers aged 20 and over. As can be seen, for this latter age group the risk of collision at 15-49 mg%, does not appear to differ from 1.0.

The age-specific risk curves for BAC's above 80 mg%, with confidence intervals placed around each data point, show that the risk estimates for both curves differ significantly from the baseline (see Figure 4). As well, the differences between the 2 age specific risk curves hold for BAC's above 80 mg%. Indeed, even at BAC's above 105 mg% the relative risk estimate is greater for drivers Age 16-19 than for older drivers. These age-specific risk curves show what appears to be 2 main effects and an interaction. The first main effect involves alcohol: as is well documented, relative risk of fatal crash increases with increasing BAC. The second main effect involves driver age: drivers aged 16-19 are at higher relative risk of fatal crash than older drivers, regardless of BAC. In addition, there is an interaction between driver age and alcohol: the age-specific risk curves are not parallel. There is a differential rate of increase in risk, which is most pronounced for young drivers whose risk curve diverges rapidly from the older age groups' risk curve at the 15-49 mg% BAC range. Thus, while risk of crash increases with increases in BAC, for both groups the rate of increase is greater for the 16-19 year-olds.

DISCUSSION

This study generally replicates what Allsop found and extends it for specific age groups: the fatal crash risk curve is different for drinking drivers of various ages. Although the fatal crash risk increases with increases in BAC for all age groups, the risk of crash is consistently
higher among young drivers aged 16-19 than among other age groups. Moreover, the rate of increase in risk with increasing BAC is greater for the 16-19 year-old drivers.

Although these results show that the young drinking driver is at significantly greater risk of fatal crash, they give us no insight into why or how alcohol and youth act, alone or in combination, to contribute to fatal crashes. The typical explanation given in the literature for this higher risk is youths' relative inexperience with driving after drinking (Cameron, 1982; Jones et al., 1978; Zylma, 1973). Essentially, learning to drink coincides with learning to drive, and when combined appear to produce much higher relative risk. What other factors contribute to this relationship are somewhat indeterminate, although several have been speculated, including immaturity, poor judgement, and a willingness to take risks (Cameron, 1982).

CONCLUSIONS

Risk factors research has been unable to take into account the complex interrelationships between alcohol, other factors (such as inexperience, the characteristics of youth who choose to drive after drinking), and fatal crash risk. A better understanding of this relationship is clearly needed for the development of countermeasures. Within this context, the findings reported in this paper seem to provide empirical support for alcohol-specific countermeasures aimed at young drivers, including: 1) lower statutory BAC limits for drivers aged 16 to 19 years; and 2) license restrictions prohibiting their driving after any alcohol consumption during probationary periods. Certainly, the high risk of fatal crash for young drinking drivers underscores the importance of alcohol as a risk factor and, thereby, a major concern for traffic safety, but it also serves to illustrate the complexities and limitations associated with focusing on a single variable like alcohol in developing restrictive measures. For example, almost by definition, the high risk for young drinking drivers occurs as a function of the incidence of such individuals in the population at risk. Of considerable interest, among nighttime drinking drivers on the road, the least frequent are the young. In fact, young people account for a steadily decreasing proportion of drinking drivers as BAC increases. Thus, young people seldom drink and drive, compared to older drivers, and when they do drive after drinking, they tend to have consumed appreciably less alcohol than have older drivers. This information is not contradictory with that previously presented on relative risk of fatal crash. Young drivers are the least likely to have been drinking, but for
those that do drink and drive there is a particularly high risk of fatal crash. Given these observations, it becomes necessary to reconsider the potential effect of an alcohol specific countermeasure aimed at all young drivers when few young people drive after drinking.

REFERENCES


Relative Risk of Crash
As a Function of BAC

Figure 1. Relative risk of crash as a function of BAC: results of 5 studies.
Figure 2. Relative risk of fatal crash as a function of BAC and Age.
Figure 3. Relative risk of fatal crash as a function of low-level BAC.
Figure 4. Relative risk of fatal crash as a function of high-level BAC.